Operator Instruction Manual

Lovibond®

TR 500/ 520

Lovibond® Colour Measurement

938245 Version 1.0

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Instructions

The TR Series of spectrophotometers are easy-to-use and stable with accurate color measurement, powerful functionality and are leading the position in the color industry. They are widely used in plastics, electronics, paints, textiles, printing, automobile, medical, cosmetic and food industries or science research institutes and laboratories.

With the D/8 geometric optical illumination recommended by CIE, the instruments can measure SCI / SCE reflectance data of sample or fluorescent sample, and can accurately measure and indicate all color difference formulas and color indexes in various color spaces. By using the instruments, it is easy to achieve accurate color transmission. The instruments can also be used as accurate measuring equipment for color matching system and are widely used in the area of color quality control. The instruments are equipped with high-end color management software which can be connected to a PC (not supplied) to achieve more extensive functionality.

Cautions

- The spectrophotometer is a precise measuring instrument. Please avoid any drastic changes of external environment when measuring. These changes, including the flicker of surrounding light and the rapid change of temperature, will affect measurement accuracy.
- Keep the instrument balanceable; make sure the measuring aperture touches the surface of the test sample gently, and there is no shaking or shifting when measuring. Please do not knock or drop the colorimeter.

- The instrument is not waterproof. Do not use it in a high humidity environment or in water.
- Keep the instrument clean. Avoid dust, powder or solid particles entering the measuring aperture and the instrument.
- Replace the white calibration cover and put the spectrophotometer into the instrument case when not in use.
- Please take out the battery to prevent the instrument from damage if you are not using it for a long time.
- Please keep the instrument in a cool dry place.
- Any unauthorized changes to the instrument are not permitted and may affect the measuring accuracy, even causing irreversible damage.

Figure 1
Instrument Structure Diagram

1. Port Description

1. Power Switch 1/0: Push the switch to "1" to turn on the instrument. Push the switch to "0" to turn it off.
2. Switch / Testing button: Press for 3 seconds to turn power ON/OFF, short press to take a measurement.
3. Indicator light: LED light includes green, yellow and red.
* Turns to red when battery is charging and turns to green when battery is full.
* LED light turns to red when the instrument is switching on if no black/white calibration has been carried out or is out of validation. No measurement can be performed.
* LED light turns to yellow when measuring and turns to green when finished. If, during measurement, the instrument is knocked or the measuring data is abnormal, the LED light turns to red when finished and the measuring date needs to be checked.
* LED light turns to yellow when carrying out the black/white calibration. LED turns to green when calibration has succeeded and turns to red if the calibration fails.
4. DC Power Port / USB / RS-232: A common interface. The instrument will judge the connection status automatically. The DC Power Port can connect to the AC adapter for charging. The adapter specification is 5V, The USB port is used to transfer data to a PC (not supplied). The RS-232 port is used to connect to the printer (not supplied).
5. Aperture switch: used for changing the measurement aperture. Setting this switch to "MAV", changes to Φ8mm aperture. Setting this switch to "SAV", changes to Φ4mm aperture.

2. Operating Instruction

2.1 Power On& Off

The instrument supports both hard power 'on & off' and soft power 'on & off'. As per Figure 1, setting the power switch to "0" turns the power OFF, and setting it to "1" turns the power ON. The instrument will enter into soft turn off after a long period of no operation (please see chart 3.8.10 for backlight time. Press "Power/Test" button for 3 seconds to turn on. Press "Power/Test" button for 3 seconds turn off the instrument.

After the instrument is turned on, it will display the screen as shown in Figure 2 if the black/white calibration is out of validation or the turn-on calibration is set. Otherwise it will display the screen as shown in Figure 3, the measurement interface.
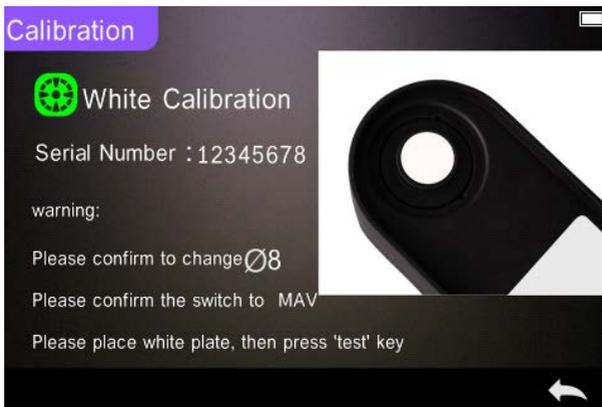
Figure 2 White and Black Calibration

Figure 3 Standard Measurement
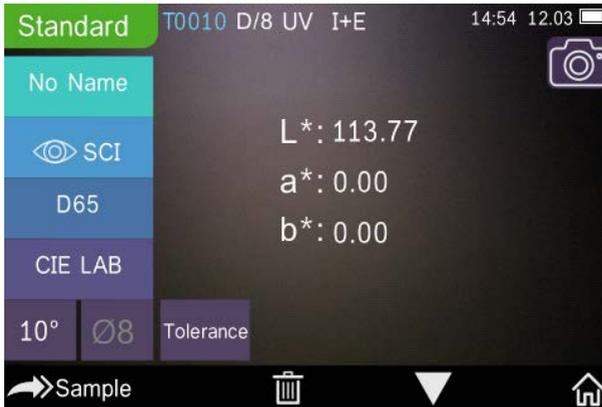
2.2 Calibration

In the measurement interface, click " 🏠 " to enter the main menu. In other displays, pleas click " ✓ " or " ← " to enter the main menu, as shown in Figure 4.
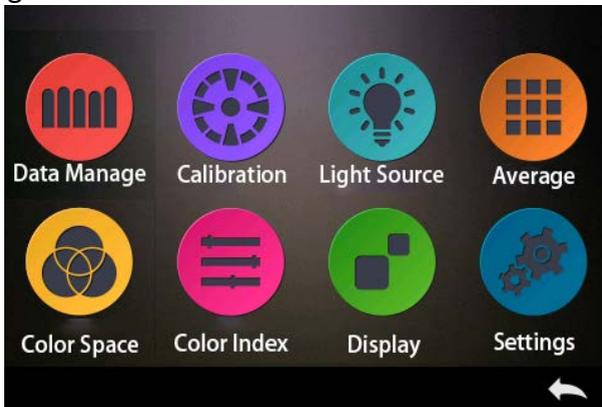

Figure 4 Main Menu

Select "Calibration" to enter the white and black calibration interface as shown in Figure 5. It will show if the calibration is valid or not, and the remaining time if it is valid.
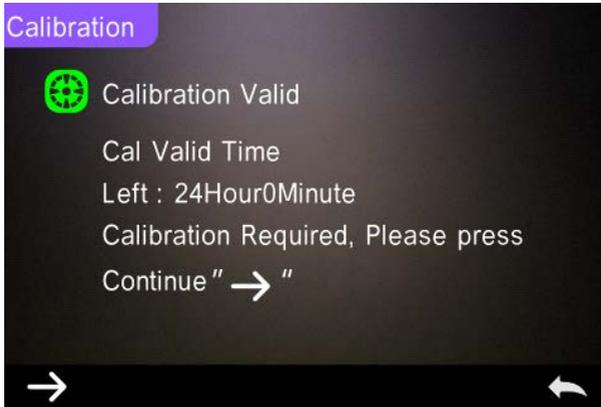
Figure 5 White and Black Calibration

Click "→" to continue and enter "White Calibration" as shown in Figure 2. Per the warning, confirm the serial number of the white calibration plate corresponds to the instrument and correct aperture setting, then put the measuring aperture on the white plate and press "Testing" button for white calibration, or click "←" to cancel and quit the calibration.

After white calibration, it will prompt you to carry out the black calibration as shown in Figure 6. Per the warning, put the measuring aperture on the black plate and press the "Testing" button for black calibration, or click "←" to cancel and quit the calibration.

Figure 6 Black Calibration

After the black calibration has finished, the instrument will automatically enter the main menu, follow the menu for settings and operations, and click "⬅" to return to "Standard Measurement".

2.3 Measurement

2.3.1 Measurement Instruction

As shown in Figures 7, 8, 9, there is a User Interface area at the top of the measurement interface which displays the status of the measurement mode (SCI/SCE), Bluetooth and UV conditions. On the left side, the is a shortcut display where you can switch between different modes by pressing the icons. In the middle, it displays different chromatic data according to the different settings of color formula. There is a further operation buttons area at the bottom, where again you can operate the data by pressing the icons.
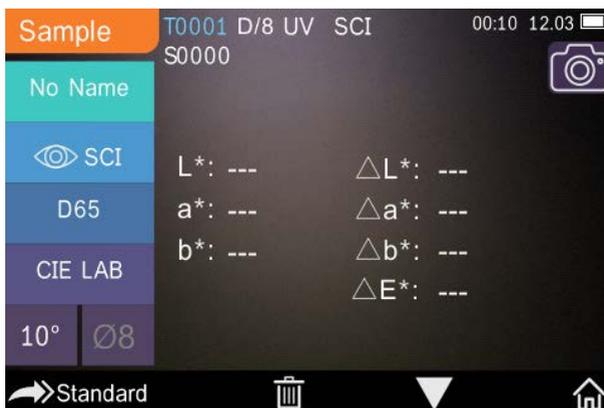
Figure 7 Sample Measurement

Figure 8 shows the spectral reflectance interface and Figure 9 displays the color index interface. Click " ▼ " to move between the screens.

Figure 8 Spectral Reflectance

Figure 9 Color Index

2.3.2 Standard Measurement

Please enter the "Standard Measurement" menu to perform measurements as shown in Figure 10.

Put the measuring aperture tightly over the standard sample, press "Testing" key. There is a "Beep" sound, and the LED indication light will turn to green from yellow. Then it shows the measurement has finished as shown in Figure 10 and in Figure 11.

Figure 10 Standard Measurement

Figure 11 Reflectance of Standard Measurement

Detailed instructions of standard measurement:

1. Interface Title: Indicating it is in Standard Measurement mode
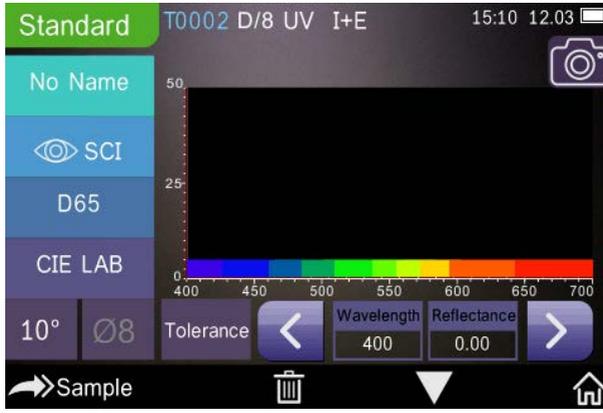2. Status Area: displays system settings such as the current serial number, lighting source, UV (on/off), Bluetooth (on/off), measurement mode (I+E mode cannot be used under Standard Measurement), and the current time, date and power etc. Only if the Bluetooth or UV functions are turned on, will they be highlighted.
3. Camera Locating: Click to use the camera to position the measurement area, then press "Testing" button to complete measurement.
4. Serial number of standard: This is automatically generated by the system and ranges from T0001 to T1000.
5. Standard Name: Displays the current measurement standard name. The default is "No Name". Click it to quickly modify.
6. Display mode: Click between "⊜SCI" and "⊜SCE" to switch between modes.

Note: Switching between SCI snd SCE modes only affects how the current data is displayed. The sample measurement mode "SCI/SCE/I+E" must be set-up in the system's settings (See 3.8.5). The Standard Measurement mode is set to I+E.

7. Light Source: Click the shortcut key to switch between different lightings D 6 5、A、C、F 1 ~ F 1 2 etc.
8. Color space: Click the shortcut key to switch between different color spaces CIE lab、CIE XYZ、Hunter lab etc.
9. Observer angle: Click to switch between the observer angle 10 and 2.
10. Switch to sample measurement: Click ➡️Sample to sample measurement.
11. Measurement aperture: Indicates the current measurement aperture in use.
12. Tolerance setting: Click to set the tolerance of the current sample.
13. Delete/Save: If the auto-save function opens, click 🗑 to delete the current data. If the auto-save function closes, it will display the save button. Click "💾" to save the current data.
14. Page Turing: Click 🔽 to quickly switch the current data between the data display area, the spectrum display area and the color index display area (please see the settings of color index as shown in Figure 36).
15. Wavelength switch button: As shown in Figure 11, click ◁ or ▷ , the wave length and reflectance of the current sample will switch in a range of 10nm intervals.
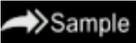
Note: If the auto-save function is turned off, the save button "💾" will display rather than the delete 🗑 button. Click "💾" to save the current data.

2.3.3 Sample Measurement

After testing the standard, click ![Sample] to enter the Sample Measurement interface. Put the measuring aperture tightly over the sample to be measured and press "Testing" key. There is a "Beep" sound and the LED indication light will turn from yellow to green. It then shows measurement fini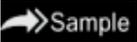shed as shown in Figure 12 and Figure 13. Sample measurement is similar to standard measurement but it will display the color difference between the current standard and the measured sample.

Detailed instructions of sample measurement:

1. Interface Title: Indicating it is Sample Measurement mode.
2. Standard Serial No: the current serial number of the standard, starting with T followed by a numerical value, and all sample chromatic data is based on the current standard.
3. Sample Serial No: the current serial number of the sample, starting with S followed by a numerical value generated automatically by the system, uniquely identifying the current sample.
4. Standard Name: Displays the current measurement's Standard's Name. The default is "No Name". Click it to quickly modify.
5. Display mode: Click between "⊚SCE" and "⊚SCI" to switch between modes

Note: Switching between SCI and SCE modes only affects how the current data is displayed. The Sample Measurement mode "SCI/SCE/I+E" must be set-up in the system's settings (See 3.8.5). The Standard Measurement model is set to I+E. If the current Sample Measurement mode is set to SCI (the screen will display SCI), the instrument only measures SCI data; if the mode is set to SCE, it will display "-----" because there is no measurement for SCI data or reflectance and color index data under SCE mode.

6. Sample Chromatic Data: Displays the current chromatic data.
7. Delta E (Color Difference): The color difference between the standard and sample.
8. Measurement Result: Displays the test result under the color formula and tolerance. If the result is greater than the tolerance value, it will show red "Failure". This function only exists when you turn on the function of "Display Measurement Result" in the system's setting.
9. Color Offset: Color Offset is only displayed when the function has been turned on in system's setting.
10. Wavelength switch button: As shown in Figure 13, click $<$ or $>$, the wave length and reflectance of the current sample will switch in a range of 10nm intervals.

Figure 12 Sample Measurement

Figure 13 Reflectance of Sample Measurement

2.3.4 Average Measurement

If the measured sample is very large or not very uniform, it needs to be measured at several points to get an average reflectance, showing the sample's true chromatic value. This instrument can achieve 2-99 times average measurement.

In the main menu, click "Average Measurement" as shown in Figure 14, input average times and click ✔ to confirm.

If 1 is inputted, it measures as usual; if more than 1 is inputted, it will generate measurement results according to the average times under standard and sample measurement.
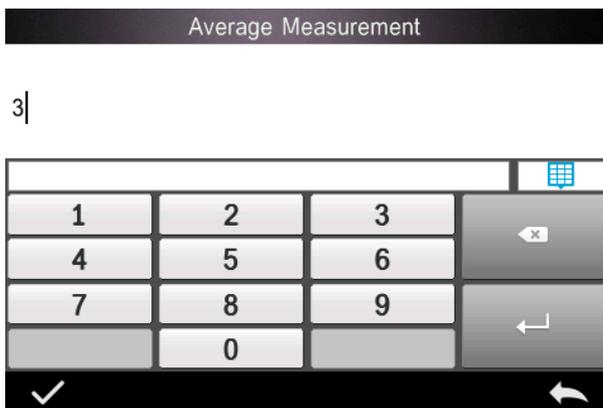
Figure 14 Average Measurement

2.4 Connecting to a PC

The instrument has a PC software package with powerful extended functionality, and it can perform more chromatic data analysis. It can connect to a PC (not supplied with the instrument) through a USB cable or Bluetooth® (only for the models with Bluetooth® functionality).

2.4.1 USB Connection

First install the software on the computer, then use USB cable to connect PC and the instrument. The software will aromatically connect to the instrument. If it successes to connect, it will display the icon of USB connection, then measure the sample and standard or analyze the data on the computer. But if not, it won't display any.

2.4.2 Bluetooth® Connection

For those models with Bluetooth® functionality, it can connect to the

PC software wirelessly.

After installing the PC software, open the Bluetooth® function in the system's settings and select the Bluetooth® option in the PC software setting. If the connection is successful, the instrument can measure the sample and standard and analyze the data on the computer. For more information about Bluetooth®, the Bluetooth® adapter and the PC software, please follow the steps on the software user manual.

2.5 Printer

A Micro Printer is an optional accessory and may be purchased separately.

Users should measure the sample first and save all records. Then connect the micro printer via the USB cable. Find the printed data from the sample or standard records as shown in Figure 15, click "Operate" Operate in the menu as shown in Figure 16, and select "Print Data" to print the current data files.
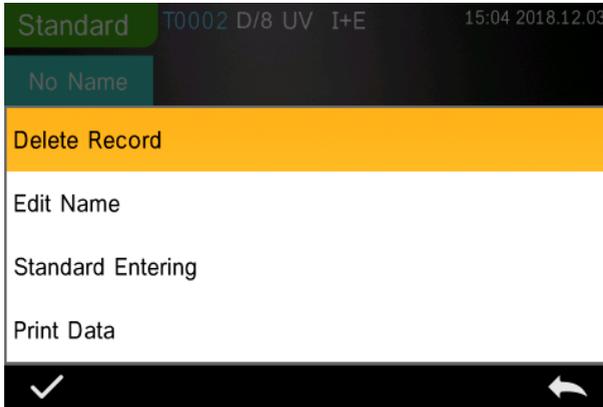

Figure 15 Print Operation

Figure 16 Print Data

3. Main Menu

Click 🏠 on the measurement interface screen or ← on other screens to enter the main menu and set all the system functions from the appropriate submenu.

3.1 Data Management

Click "Data Manage" in the main menu to enter the data management interface as shown in Figure 17. The data management area enables checking records, searching and interacting with measured records and manually inputting standard data.
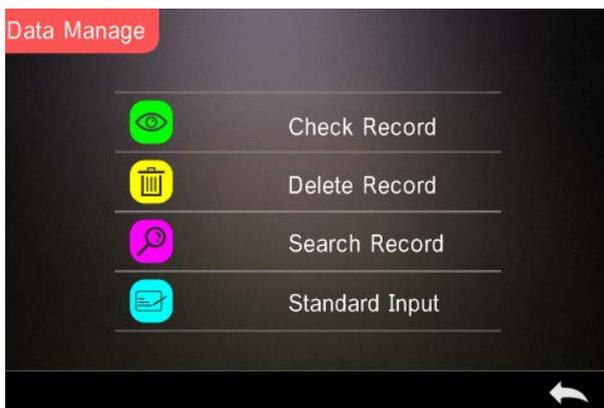
Figure 17 Data Management

3.1.1 Check Record

1. Check Standard Record

Select "Check Record" to enter the "Standard Record" screen as shown in Figure 18. The screen shows the standard light mode, UV status and the measurement mode, and the measurement time and date.
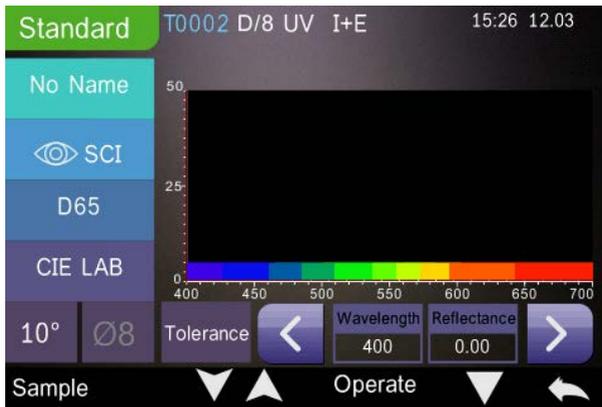

Figure 18 Standard Record

Figure 19 Reflectance of Standard Record

Click ▼ or ▲ to check the previous or next record.

Click ▼ to switch between chromatic data, reflectance, and color index as shown in Figure 18 and in Figure 19.

Click "Operate" to delete a record, edit a name, enter a standard and print data as shown in Figure 16.

Delete record: Click "Delete Record" to delete data as shown in Figure 20, and click ✓ to confirm or ↩ to cancel the deletion and return to the menu.
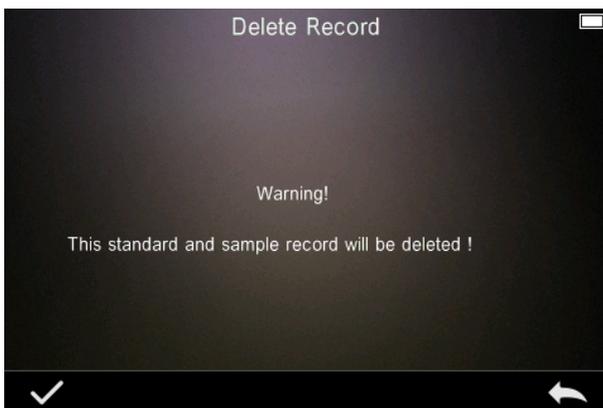
Figure 20 Delete Record

Edit Name: Click "edit name" on the screen as shown in Figure 21. Input the new name (maximum 8 characters), click ✓ to confirm or ← to cancel.

Figure 21 Edit Name

Enter Standard: Click "Standard entering" to set the standard record to the current standard as shown in Figure 22, and click "Sample" to make a sample measurement.

Figure 22 Standard Entering

Print Data: Click "Print data" to print the current record data to the micro printer.

2. Check Sample Record

Click "Sample" on the Standard Record screen to check the sample record as shown in Figure 23.
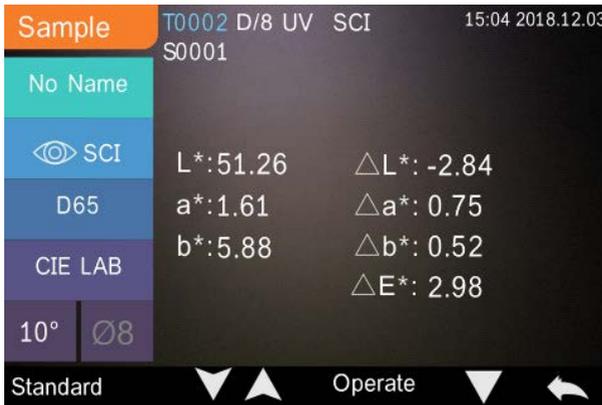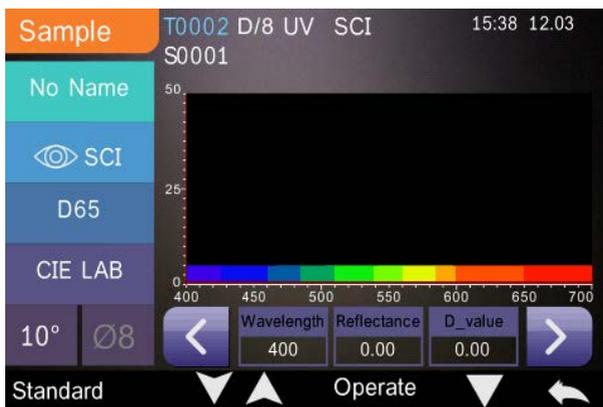

Figure 23 Sample Record

Figure 24 Reflectance of Sample Record

Click ▼ or ▲ to check the previous or next record.

Click ▼ to switch between chromatic data, reflectance and color index as shown in Figure 23 and in Figure 24.

Click "Operate" to delete a record, edit a name, enter a standard and print data. It is the same as the operation for Standard Record.

3.1.2 Delete Record

On the data management screen, click "Delete Record" to enter the delete record screen as shown in Figure 25. Delete records include the option to "Delete All Samples" and "Delete All Records".

Click the corresponding option, a warning interface will appear, clicking ✔ will delete all corresponding records; clicking ⬅ will cancel the operation, as shown in Figure 26.
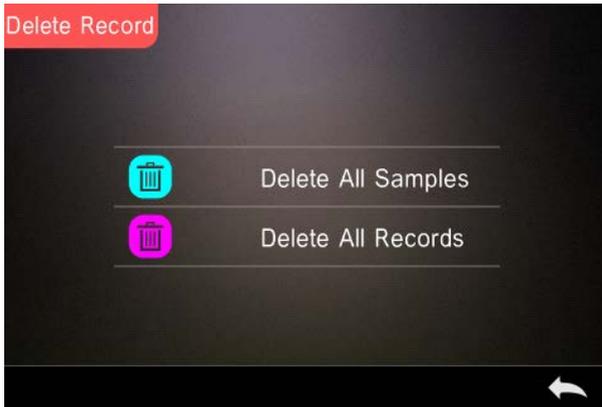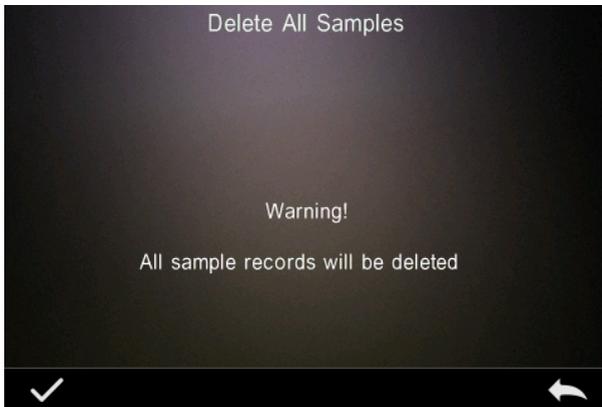
Figure 25 Delete Record

Figure 26 Delete All Samples

3.1.3 Search Record

On the data management screen, click "Search Record" to enter the search menu, as shown in Figure 27. Here there is the option to "Search Standard Name", "Search Standard Index" and "Search Sample Name".

Figure 27 Search Record

1. Search Standard Name

Click "Search Standard Name", a window appears with Input Search Name as shown in Figure 28. Input the name or contained character, then click ✓ to confirm, the instrument will automatically search all the standard records and list all matching records, as shown in Figure 29, click ▼ and ▲ to scroll through all matching results.

If there is no matching record, it will prompt "This record is empty" and return to the search record menu.
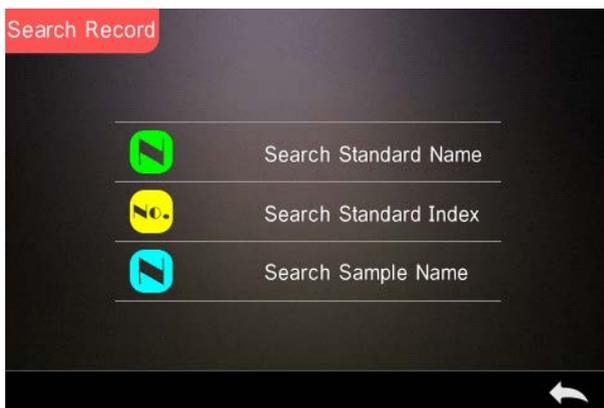
Figure 28 Input Search Name

Figure 29 Search Record

1. Search Standard Index

Click "Search Standard Index", a window appears with "Input Search Index" as shown in Figure 28. Input the search requirement and then click ✓ to execute the search. The instrument will automatically search all standard records and list all matching results.

28

Figure 30 Input Search Index

1) Search Sample Name

Click "Search Sample Name", as shown in Figure 28. Input the searched sample name or a contained character, then click ✓ to confirm. The instrument will automatically search all the Sample Name records and list all matching results.

3.1.4 Standard Input

On the data management screen, click "standard input" to enter the Standard Input screen as shown in Figure 31.
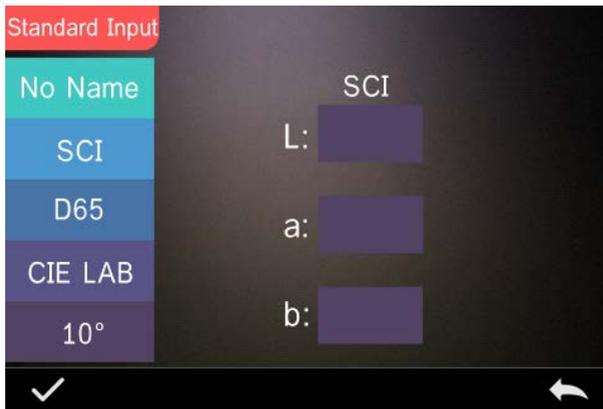
Figure 31 Standard Input

Click "Name" to input the standard name.

Click "Measurement Mode" to set the standard measurement mode, including SCI, SCE, SCI+SCE.

Click "Standard Light Source" to set the standard light source.

Click "Color Space" to select the color space. At present, the instrument supports CIE LAB, CIE Lch, CIE XYZ, CIE Yxy, CIE LUV.

Click "Observer Angle" to set the standard observer angle (2 or 10 degree).

Click "Chroma Coordinates" to enter the corresponding chromatic value, click "L" to input L value as shown in Figure 32, input the corresponding L value and confirm. Input all standard values and click ✓ to confirm. The standard will be stored in the standard record list. The standard index is cumulative.

Note: In the instrument, users cannot manually input the reflectance results and the input standard data is only valid in

accordance with the current observer angle, measurement mode and light source. In the check standard record screen, if the observer angle, measurement mode and / or the light source have changed, the corresponding chromatic data will be displayed as "- - - - -".
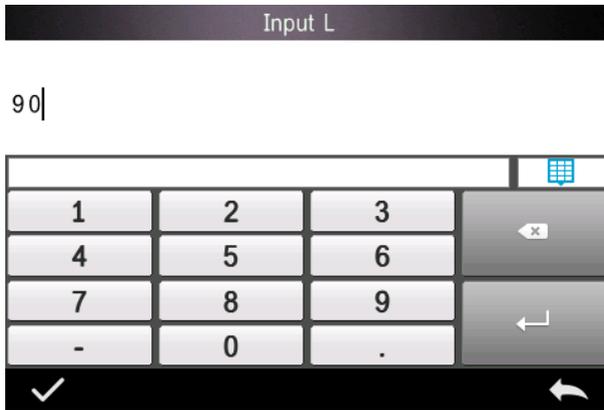
Figure 32 Input L Value

3.2 Calibration

White and black calibration, as a standard verification for chromatic data, is required to be done correctly. Incorrect calibration will affect the validity of the data.

Should the calibration environment be very different from the test environment of sample to be measured (for example, an extreme difference in temperature), it is recommended to re-calibrate the instrument on-site. It is also recommended to re-calibrate the instrument if the las successful calibration was more than 24 hours previously.

Black and white plate must be cleaned regularly and kept in dark, dustproof and dry conditions.

For black and white calibration procedures, please refer to Section 2.2.

3.3 Average

When the sample to be measured is very large or not very uniform, users need to measure several points to get an average reflectance value to show the sample's true chromatic value. This instrument can achieve 2-99 times average measurement.

In the main menu, click "Average" as shown in Figure 14, input average times and click ✓ to confirm.

If the input time is 1, the instrument measures as usual; if more than 1, it will generate measurement results after the input average times under standard and sample measurement.
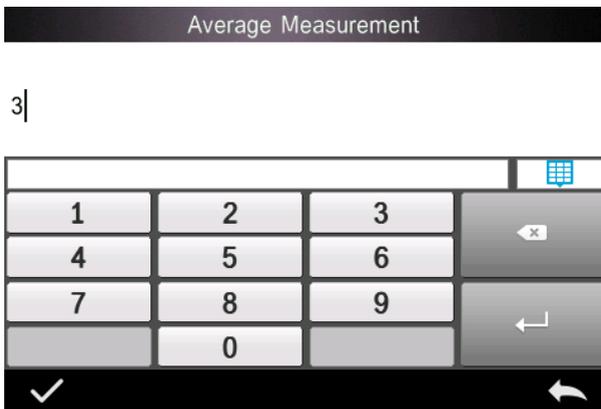

Figure 14 Average Measurement

3.4 Light Source

Users can set the corresponding light source according to the actual test conditions. In the light source setting screen, it is possible to set the standard observer angle, the standard light source and UV light source (different modes may differ).

On the main menu screen, click "light source setting" to enter the light source setting screen, as shown in Figure 33.
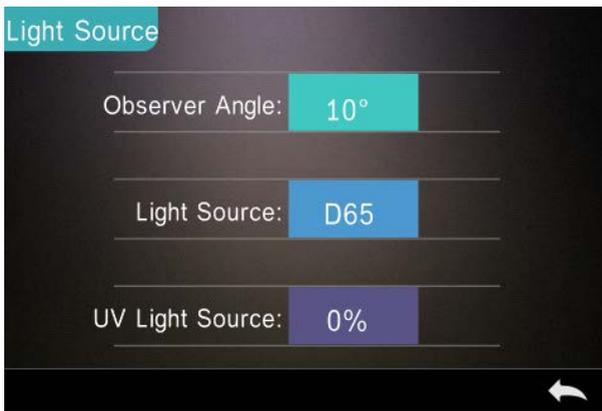
Figure 33 Light Source

Click "Observer Angle" to select 10 degrees or 2 degrees. 10 degrees is the CIE1964 standard, while 2 degrees is the CIE1931 standard.

Click "Light Source", as shown in Figure 34, select between D65, A, C, D50, D55, D75, F1, F2(CWF), F3, F4, F5, F6, F7(DLF), F8, F9, F10(TPL5), F11(TL84), F12(TL83/U30).

Click "UV Light Source" to select the UV light source switch.100% means UV light on while 0% means UV light off. It is recommended

to turn on the UV light source when measuring fluorescent samples, and turn it off when measuring general samples.

Figure 34 Light Source

3.5 Color Space

In the main menu, click "Color Space" to open the color space screen as shown in Figure 35. Select the corresponding color space and click to complete the setting.

Figure 35 Color Space

3.6 Color Index

On the Color Index screen, it is possible to select the current color formula and color index, as well as set the parameters of the color formula and metameric index, as shown in Figure 36.

3.6.1 Set Color Index

In the main menu, click "Color Index" to display the screen as shown in Figure 36. On the left there is a list of color formulas; on the upper right, there is a list of color indices; on the lower right are the Parameter Factors Settings.
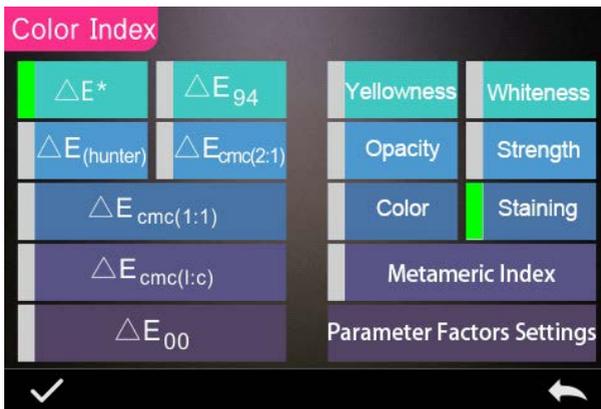

Figure 36 Color Index

Click any color formula or color index to select. Color index is optional. If you wish to cancel the selection, click the selected color index again. After selecting, click ✔ to confirm.

The selected color formula will calculate the sample color difference

when measuring the sample. For example, color formula Delta E 00 as shown in Figure 37.
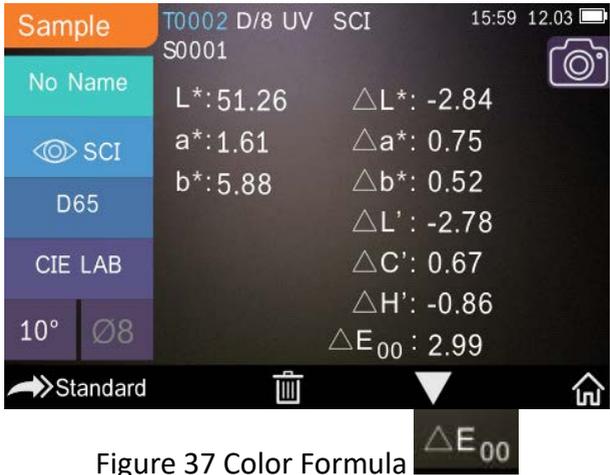

Figure 37 Color Formula $\triangle E_{00}$

The selected color index will display the color index on standard measurements and / or sample measurements. In the measurement menu or check record menu, click ▼ to the color index menu. For example, as shown below, the Yellowness index in Figure 38.

Figure 38 Yellowness Index

3.6.2 Parameter Factors Settings

In the color index menu, click "Parameter Factors Settings" as shown in Figure 39.
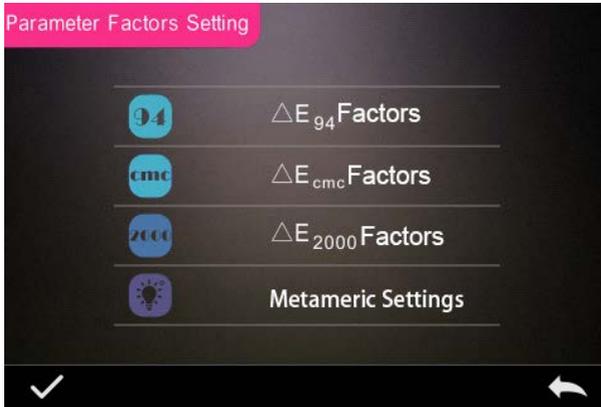
Figure 39 Parameter Factors Setting

1. Setting Factors

For C I E D E 1994 (Δ E 94), C M C (Δ E C M C (l: C)), and C I E D E 2000 (ΔE00), users can set L, C, H values (CMC only sets L and C values).

Take Δ E 94 for example, click $\triangle E_{94}Factors$ to view the menu per Figure 40.

Figure 40 Δ E 94 Factors

Click KL, KC, KH to enter the edit menu as shown in Figure 41, input a value and click ![checkmark] to confirm or ![back arrow] to cancel.

Figure 41 Factor KL

2. Metameric Index

In the Parameter Factors Settings menu, click "Metameric Index" to enter the menu per Figure 42. Individually set Light 1 and Light 2, and click ✔ to confirm or ⬅ to cancel.

Figure 42 Metameric Settings

3.7 Display Setting

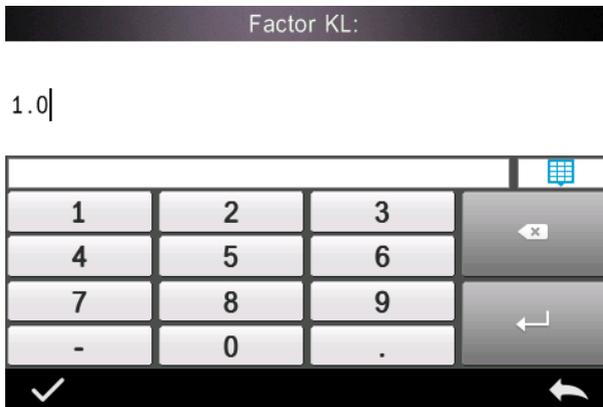In the main menu (Figure 4), click the "Display" button to show the menu per Figure 43. Here it is possible to set "Color Offset", "Test Result", and "Operation Mode".

Select the button to turn the "Color Offset" on (as shown in Figure 12) or off.

Select the "Test Result" button to turn on or off. When turned On, the instrument will highlight the tolerance values: when the measurement result is larger than the tolerance value, it will display red and prompt failure; when the measurement result is smaller than the tolerance value, it will display green and prompt pass.

The instrument's default Operation Mode is right-handed. If you wish for left-handed operation mode, this can be changed by selecting the button.
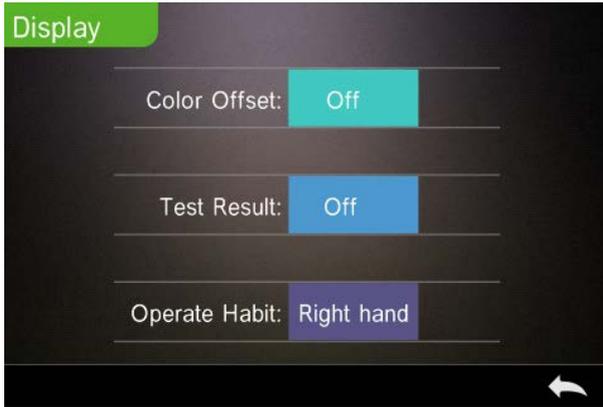
Figure 43 Display

3.8 System Setting

In the main menu, click "System Setting" to view the menus per Figure 44, Figure 45 and Figure 46.
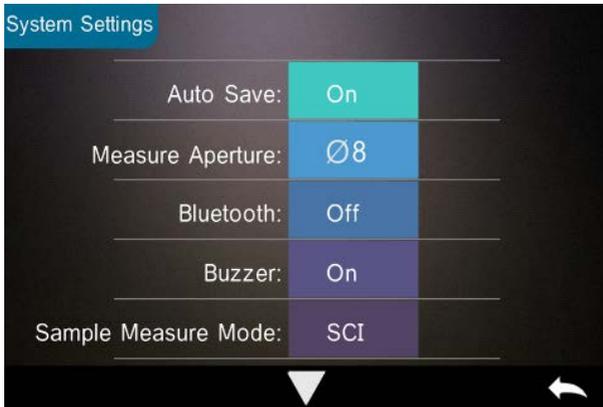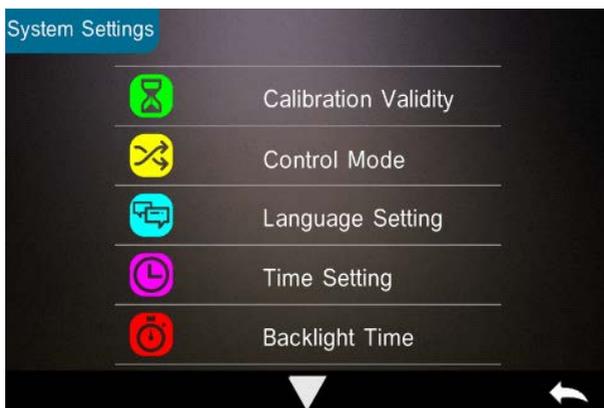

Figure 44 System Settings
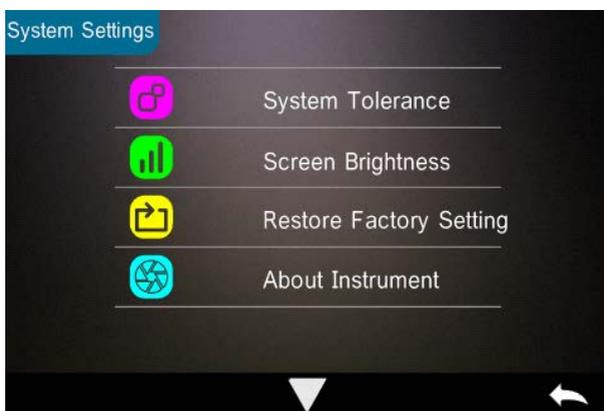
Figure 45 System Settings

Figure 46 System Settings

3.8.1 Auto Save

When the Auto Save function is turned on, the instrument will automatically save the data when it is measured. When it is turned off, it is necessary to manually save the date by clicking " 🖫 " .

3.8.2 Measurement Aperture

Depending on the model, the TR 520 / 500 series has the following aperture options:
TR 520: Dual Aperture: 10mm/8mm & 5mm/4mm
TR 500: Customized Aperture: 8mm/4mm/1x3mm

When measuring a large or non-uniformed sample, it is recommended to use the 8mm aperture. For small samples, a 4mm aperture is preferred.

To change the aperture, follow the procedure as defined below.

Step 1: As shown in Figure 47, rotate the measurement aperture counterclockwise and remove. Then install the new aperture with a clockwise rotation until a click can be heard.

Step 2: Use the Aperture Switch (see Figure 1 and 47) to select the aperture setting:
Φ4mm aperture = SAV
Φ8mm aperture = MAV.

Step 3: Switch the default system measurement aperture in the System Settings (see Figure 44) to correspond with the actual measurement aperture. When the measurement aperture is switched, it is essential to re-calibrate the instrument according to part 2.2.

Note: If the aperture setting and system settings are not aligned, it could cause false readings.

Figure 47 Measurement Aperture

3.8.3 Bluetooth

The Bluetooth® interface of TR series is 4.0 Dual Mode (compatible with 2.1) which can connect to the PC and software.

When Bluetooth® is on, the icon ⚹| will display on the screen.

After installing the PC software, turn on the Bluetooth® and set up the connection. Once connected, the sample and standard measurements can be transferred to the PC for analysis. For further details, please refer to the Software User Manual.

3.8.4 Buzzer Switch

In the System Settings, the "Buzzer Switch" can be set to "On" or "Off". When "On", a sound will be heard when making a measurement.

3.8.5 Sample Measurement Mode

SCI : Specular Component Included
SCE : Specular Component Excluded

In SCI mode, the instrument utilises an internal mechanical optical trap that covers the specular port, completing the sphere.

On Sample measurement, the instrument will measure according to a users' setting.

The default measurement mode is complete SCI and SCE measurement (SCI+SCE), with a test time of approx. 3 seconds.

Single SCI or SCE modes can also be set. In this case, test time is approx. 1.5 seconds.

3.8.6 Calibration Validity

For black and white calibration procedures, please refer to Section 2.2.

White and black calibration, as a standard verification for chromatic data, is required to be done correctly. Incorrect calibration will affect the validity of the data. Should the calibration environment be very different from the test environment of sample to be measured (for example, an extreme difference in temperature), it is recommended to re-calibrate the instrument on-site. It is also recommended to re-calibrate the instrument if the las successful calibration was more than 24 hours previously.

In the system menu, click "Calibration Validity" to select the menu per Figure 48.

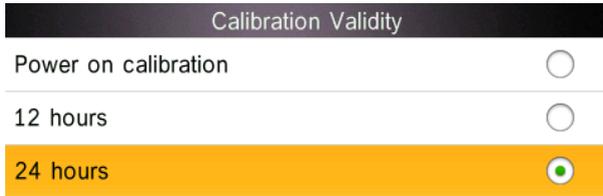| Calibration Validity	
Power on calibration	○
12 hours	○
24 hours	⦿

Figure 48 Calibration Validity

If power on calibration is selected, the instrument will request a white and black calibration every time it is turned on. Otherwise, it will only be able to check records but not carry out measurements.

If 12 Hours validity is selected, the validity of the Calibration will expire after 12 hours. Once expired, the instrument will only able to check records but not carry out measurements.

If 24 Hours validity is selected, the validity of Calibration will expire after 24 hours. Once expired, the instrument will only able to check records but not carry out measurements.

When the validity of the Calibration expires, a warning red light will be shown in the LED. Once re-calibrated, the LED light will turn green.

3.8.7 Control Mode

When the instrument is connected to the PC software, the user can set the specific measurement control mode.

In the System Settings menu, click "Control Mode" to select as shown in Figure 49. There are three options: Key, PC software, Key and PC software.

Key: When selected, the instrument can only be controlled by the keys to complete the test. Data can then be uploaded to the PC software when connected.

PC software: When selected, the instrument can only be controlled via the PC software to complete the test.

Key and PC software: When selected, this instrument can be controlled by the keys or via the PC software to complete the test. This mode is the default for the instrument.

Note: The control mode is only valid when connected to the PC software. If unconnected, it is only controlled by the instrument's keys.

Figure 49 Control Mode

3.8.8 Language Setting

Click "Language Setting" in "Settings" menu to choose between English, French, German, Spanish, Portuguese or Chinese.

3.8.9 Time Setting

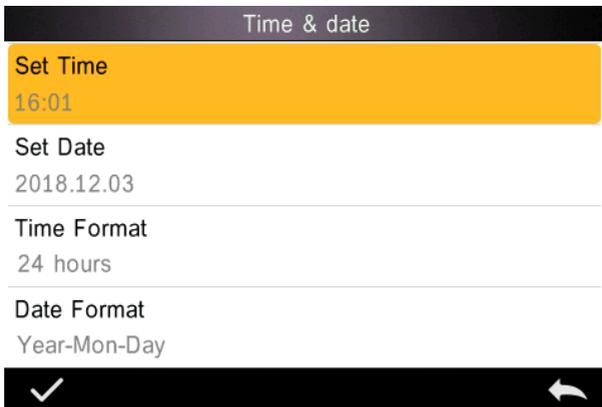In the Setting menu, click "Time setting" as shown in Figure 50.

Figure 50 Time & Date

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1) Click "Set Time" to set the current time.

2) Click "Set Date" to set the current date.

3) Click "Time Format" to set the required time format.

4) Click "Date Format" to set the required date format. There are three options: "Year Month Day"/ "Month Day Year"/ "Day Month Year".

3.8.10 Backlight Time

Click "Backlight Time" in "Settings". This sets the preferred backlight time.

Backlight time includes: "normally open", "5 minutes", "60 seconds", "30 seconds", "15 seconds". If "normally open" is selected, the instrument will work until the power is turned off to automatically shut down.

If "60 seconds" is selected, it will work from the last operation. After 3 minutes, it will automatically enter soft power-off into power saving mode. "5 minutes", "30 seconds", "15 Seconds" is the same as above.

3.8.11 System Tolerance

Click "System Tolerance" to control all tolerance and default setting is system tolerance.

Set tolerance for current sample according to requirements. $\triangle E^*$ is for setting the general tolerance. $\triangle L^*$ is for setting the tolerance of the standard brightness. The right side of $\triangle L^*$ is the upper limit of tolerance which must be higher than the left side of the $\triangle L^*$ which is the lower limit of the tolerance. The same as the $\triangle a^*$ and $\triangle b^*$.

3.8.12 Screen Brightness

Click "Screen Brightness" in "Settings" where the brightness can be adjusted by "+" and "-".

3.8.13 Restore Factory Settings

Click "Restore Factory Setting" in "Settings" as shown in Figure 51. Click ✅ , the instrument will restore factory settings and all records will be cleared, or click ⬅ to cancel this operation.

Note: Restoring factory settings **will delete all test data and settings**. All are irrecoverable so please operate with caution.

Figure 51 Restore Factory Setting

3.8.14 Working Mode

When measuring liquids, powders or paste, users need to set the instrument to "Liquid Measurement" mode. Select "Work Mode in

the System Settings and set to Component Mode. For general reflection measurements, set the instrument to Portable Mode.

4. Daily Maintenance

1. The instrument is a precision optical instrument. Please keep it safe: avoid wet conditions, strong electromagnetic forces, interference, light and dust. Please keep and use the instrument in a standard laboratory environment (temperature 20 degrees Celsius, 1 standard atmospheric pressure, humidity 50 ~ 70% RH).

2. The white plate is a precision optical component. Please keep it safely and avoid any sharp objects scratching the surface, any staining of the working surface with dirt, any lengthened exposure to light. Softly wipe regularly with alcohol to clean the white board surface. Before calibrating, clean the dust off the surface.

3. In order to ensure accuracy of the test data, it is advised to send the instrument and white plate back to the manufacturer or a qualified representative for calibration after one year.

4. The instrument has a built-in lithium battery. If you do not use the instrument for a long time, please charge it every 2 weeks to protect the performance of the lithium batteries and extend the life of the batteries.

5. Please do not disassemble the instrument. If there are any questions, please contact the relevant after-sales staff. Do not remove any labels, or it will affect its after-sales maintenance service.

5. Technical Parameters

5.1 Technical Specifications

Model \ Items	TR 520	TR 500
Optical Geometry	Reflect: di:8°, de:8° (diffused illumination, 8-degree viewing angle)	
Integrating Sphere Size	48mm	
Light Source	Combined LED Light, UV Light	Combined LED Light
Spectrophotometric Mode	Concave Grating	
Sensor	256 Image Element Double Array CMOS Image Sensor	
Wavelength Range	400-700nm	
Wavelength Interval	10nm	
Semiband Width	10nm	
Measured Reflectance Range	0-200%	
Measuring Aperture	Dual Aperture: 10mm/8mm & 5mm/4mm	Customized Aperture: 8mm/4mm/1×3mm
Specular Component	SCI&SCE	
Color Space	CIE Lab, XYZ, Yxy, LCh, CIE LUV, Hunter LAB	
Color Difference Formula	ΔE*ab, ΔE*uv, ΔE*94, ΔE*cmc(2:1), ΔE*cmc(1:1), ΔE*00v, ΔE(Hunter)	
Other Colorimetric Index	WI(ASTM E313, CIE/ISO, AATCC, Hunter), YI(ASTM D1925, ASTM 313), TI(ASTM E313, CIE/ISO), Metamerism Index MI, Staining Fastness, Color Fastness, Color Strength, Opacity, 8° Glossiness	
Observer Angle	2°/10°	
Illuminant	D65, A, C, D50, D55, D75, F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12	D65, A, C, D50, D55, D75, F2, F7, F11
Displayed Data	Spectrogram/Values, Samples Chromaticity Values, Color Difference Values/Graph, PASS/FAIL Result, Color Offset	
Measuring Time	2.6s	

Repeatability	MAV/SCI: ΔE*≤0.03	MAV/SCI: ΔE*≤0.05
Inter-instrument Error	MAV/SCI: ΔE*≤0.15	MAV/SCI: ΔE*≤0.2
Measurement Mode	Single Measurement, Average Measurement	
Locating Method	Camera View Finder Locating	
Battery	Li-ion battery. 5000 measurements within 8 hours	
Dimension	L*W*H=184*77*105mm	
Weight	600g	
Illuminant Life Span	5 years, more than 3 million times measurements	
Display	3.5-inch TFT color LCD, Capacitive Touch Screen	
Data Port	USB, Bluetooth 4.0	
Data Storage	Standard 2000 Pcs, Sample 20000 Pcs	
Language	English, French, German, Spanish, Portuguese, Chinese	
Operating Environment	0~40℃, 0~85%RH (no condensing), Altitude < 2000m	
Storage Environment	-20~50℃, 0~85%RH (no condensing)	
Standard Accessory	Power Adapter, Built-In Li-ion Battery, User Guide, PC Software, White and Black Calibration Cavity, Dust Cover	
Optional Accessory	Micro Printer, Powder Test Box	
Note: The specifications are subject to change without notice.		

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